Stencil Circular 237 (Rev. Feb., 1949) November, 1947

# Growing STRAWBERRIES in Wisconsin

Extension Service, College of Agricultu
University of Wisconsin, Madison

# Growing STRAWBERRIES in Wisconsin

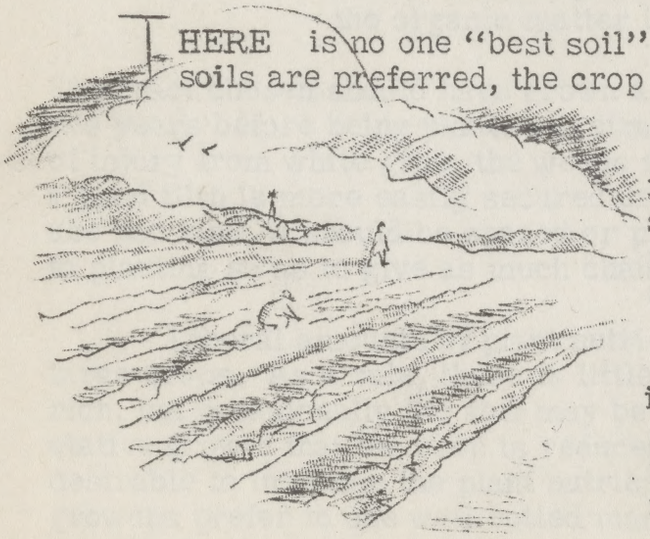
James G. Moore

THE STRAWBERRY is the most important small fruit grown in Wisconsin, both commercially and for home use. It is grown for home use in all parts of the state. Commercially, it is largely confined to areas reasonably near large markets, but in a few sections it is produced strictly for wholesale markets.

The selection of the site has much to do with successful strawberry culture, particularly where this fruit is grown commercially. The site is an important factor in earliness and in prevention of injury from late spring frosts. Strawberry plants blossom early therefore there is more danager from frost injury on low lands than on more elevated sites. If exceptionally early fruit is desired, safety from frost injury must be sacrificed to a considerable degree. For such a crop, select a site with a southern exposure and preferably with a light soil. If earliness is not of prime importance, choose a northern slope. This will retard the flowering period, which lessens the danger of injury from late frosts and causes later ripening of the fruit. The slope should be gentle so as not to favor serious soil washing. In the selection of a site for the home plantation, nearness to the house is usually of more importance than either earliness or greater safety from frost injury.

## Select as Good a Soil as Possible

THERE is no one "best soil" for strawberries. While medium light soils are preferred, the crop is grown commercially on soils ranging from rather light sands to heavy clay and black prairie loams. Excellent results may be secured on each of these soils if proper cultural practices are followed and if the right varieties are grown.



Certain qualities are necessary in any soil if good results are to be secured. A desirable soil for strawberries is one which is well drained, moderately fine, free from clods and debris, and

which contains a relatively abundant supply of well decayed vegetable (organic) matter. Soils which do not and cannot be made to possess these qualities should not be chosen for growing strawberries commercially, and will not give very satisfactory results in a home plantation.

Good drainage is necessary, with the water table far enough below the surface to allow for good root development. Provision should be made so that excessive soil moisture may be carried away readily. While the soil should be well drained of excessive moisture, it is also important that it be capable of retaining needed moisture. The production of good sized fruit and large crops demands an abundant supply of soil moisture. Ordinarily, rains occurring at fruiting time are insufficient to meet the needs of the crop, especially if most of the spring rains have run off. The soil should be in condition to catch and hold moisture. The ability of the soil to do this depends upon its texture, physical condition, and organic content. For commercial plantations, a deep, rich, well drained, sandy loam, underlaid by a subsoil of good water-holding ability, is usually preferred. Having the home planting near the house is probably more important than having an ideal soil, but suitability of the soil should not be too greatly sacrificed to proximity of the planting.

## Thorough Soil Preparation Pays

THOROUGH soil preparation is one of the most important factors in the successful culture of strawberries. It is essential to the production of large crops of fine fruit, its facilitates planting, and it reduces the work necessary later onto maintain favorable conditions.

Four things in particular need to be taken into account in the preparation of the soil:

-- The control of pests, the plant nutrient content, the organic matter in the soil, and tillage.

The tract chosen should have grown a cultivated crop for one and preferably two years before being planted to strawberries. Cultivation lessens the danger of injury from white grub; the weeds are less likely to prove troublesome; and a good tilth is more easily secured under such conditions. If it is necessary to use sod land, it should be spaded or plowed during the summer or fall previous to planting so as to give as much chance as possible for the sod to rot.

Liberal amounts of plant nutrients are essential to the production of large crops. As a rule, there is little danger of getting a strawberry soil too rich, but occasionally the soil may be so rich as to cause such vigorous vegetative growth that the crop is reduced. In practically all cases, it will be desirable to increase the plant nutrients at the time the soil is prepared. Most growers prefer to use well rotted manure for this purpose. It is usually more

economical to supplement the manure with commercial fertilizer. If necessary to use coarse (unrotted) manure, it should be applied when the soil is prepared for the crop which precedes the strawberry. If fairly well rotted, it may be applied and plowed under during the fall preceding the setting of the plantation. Well rotted manure is ordinarily applied before plowing in the spring.

## No Set Rule for Fertilization

SO MUCH depends upon the natural fertility of the soil and its previous cropping and fertilization that no general formula for the application of fertilizer would apply in all cases. Growers will find it necessary to determine largely for themselves by field trials or by analysis what is lacking in the soil and then increase the element or elements which are deficient. One should, therefore, consider carefully the character of the soil and its previous treatment when determining what fertilization will be desirable.

The amount of manure to be used varies greatly. The average application is from ten to twenty tons or loads to the acre. Some growers use as much as forty loads. It would seem to be more economical, in most cases, to use a smaller amount and to supplement it by using commercial fertilizers. Possibly a better way to determine the amount of manure would be on the basis of the organic matter that is needed. Under this method, enough manure would be put on, if available, to give the desired amount of organic matter. It would then be supplemented with commerical fertilizers.

The kinds and amounts of commercial fertilizers to be used are local and personal problems. General advice is of little value to a particular grower except to suggest what the experience of some other growers has been. To get the best results, one much consider his own particular location and conditions. A grower planting on two different tracts might get better results by using different treatments than by using the same one on both tracts.

In general, the heavier soils will need less potash and probably less phosphoric acid than the lighter soils, and when stable manure is used no commercial nitrogen fertilizer is required except possibly a light application along the rows soon after planting. On the lighter soils, an application of from 200 to 400 pounds to the acre of a complete fertilizer having a formula of around 4-12-8 should be beneficial in addition to manure, or 1000 to 1200 pounds to the acre when manure is not used. On home plantations the same practices may be followed. An application at the rate of 1000 to 1200 pounds per acre would be approximately 23 to 28 pounds per 1000 square feet.

## Do Not Neglect the Organic Matter

INCREASED AMOUNTS of plant nutrients in the soil are of little value to plants unless there is an abundance of organic matter present. Frequently the so-called poor soils have sufficient plant nutrients but are unproductive because of insufficient organic matter. As previously pointed out, the use of manure is the common method of increasing the organic matter content of soil.

If sufficient manure or similar litter cannot be secured, it is necessary to resort to green manuring when strawberries are grown on a commerical basis. Any crop which produces a large vegetative growth in a relatively short period may be used. When leguminous crops are grown for green manuring, the nitrogen content of the soil may also be increased. Some growers supply organic matter largely by growing clover in the rotation in advance of the cultivated crop. This is an excellent practice when it can be fitted into a cropping program. The urban grower will probably have to depend upon composted lawn and garden refuse for maintaining the organic supply of his home plantation.

## Good Tilth is Very Important

SOIL WHICH IS to be planted to strawberries should be plowed or spaded fairly deep. The heavier types of soil should be plowed deeper than the lighter ones. Fall plowing is desirable, particularly on heavy soils. The land should be left "rough" until spring. When this is done discing or shallow plowing should be the first tillage operation in the spring.

Thorough harrowing, planking, or other cultivation should follow to put the soil in as fine tilth as practical. It is particularly important that the upper two or three inches be fine and reasonably smooth in order that planting may be facilitated. Soils which are very loose are probably best rolled or culti-packed prior to the final harrowing before planting.

## Varities to Grow

SEVERAL FACTORS must be considered in the selection of varieties. It is quite as essential that sexual union take place for the production of a crop of berries as it is in securing offspring from animals. The strawberry plant is somewhat peculiar in that different varieties produce different kinds of flowers. Most varieties now commonly planted have flowers bearing both male and female organs, and are therefore capable of self-fertilization. Such varieties are known as "perfect", "staminate", or "male" varieties. The last two terms, however, are somewhat misleading, for the flower possesses both stamens and pistils and is therefore not only a male but a female flower as well.

A few varieties listed by nurserymen have only the female organs present, and therefore cannot produce fruit without the presence of a stamen-bearing or perfect variety. Varieties having only the female sex organs are called "imperfect", "pistillate", or "female" varieties.

If an imperfect variety is to be grown, care must be taken to select a perfect variety to be planted with it so as to provide for pollination. If a variety is to act as a pollinizer of another, both must be in flower at the same time. In fact,

it is desirable to have a perfect variety in which the blooming period is longer than that of the imperfect so that the ripe pollen may be available at all times when the imperfect variety is in bloom. The perfect variety should produce a large amount of pollen. Varieties differ materially in this respect, but unless conditions are very favorable, shy-pollen-producers will not give good pollination of imperfect varieties.

## What Varieties Are Best

STRAWBERRIES may be grouped into two classes, those which produce their fruit during the early summer; and the "everbearing" or those which produce an early crop and later another crop, continuing until cold weather prevents further production. The latter class is not important in Wisconsin, although it is grown to a limited extent in home plantations.

A study of varieties being grown shows that, regardless of varying soil conditions, practically the same varieties are quite generally used in all parts of the state. This would indicate that these varieties are cosmopolitan and can be recommended as doing reasonably well under widely varying conditions. A commercial grower should not be satisfied with average results. He should constantly be trying out a limited number of other varieties in comparison with the ones that he is growing in an attempt to find, if possible, the varieties which are best adapted to his conditions. It is some trouble and expense to run a trial plot for testing varieties, but it is quite likely to prove a paying investment.

Premier and Beaver are the varieties most extensively grown commercially in Wisconsin at present, although Beaver is less grown than formerly. Catskill is being planted quite extensively. Senator Dunlap is still a favorite in many home plantations. Robinson is a vew variety which has gained considerable popularity recently.

Premier: Is quite generally planted as an early variety. It is a rather shy runner producer and needs to be planted somewhat closer than most varieties.

Beaver: A Wisconsin variety which has gained much popularity in commercial sections that have light soils. It is an early variety and is especially well adapted to shipping and canning.

Catskill: A mid-season variety, reported to be a heavy producer, gives promise of becoming popular for commercial plantings.

Senator Dunlap: Was for a long time a leading variety in Wisconsin, both with commercial and home growers. It seems to be unusually well adapted to a wide range of conditions. It is a heavy plant maker, and care should be taken, therefore, not to let the row become too thick as production is reduced when this occurs.

Robinson: Is an early, large-fruited variety of good quality, a heavy plant maker, and said to be very satisfactory for freezing. It was originated in south-

western Michigan where it is extensively planted. It is gaining favor in Wisconsin. Kardinal King and Scarlet Beauty are said to be identical.

Everbearing varieties are discussed on page 16.

## Character of Plants Desired

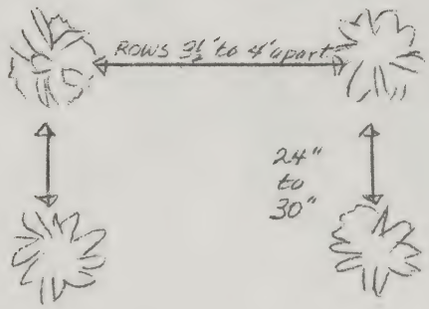
GOOD PLANTS are necessary for the best results. Three things largely determine the desirability of a plant: age, character of the root system, and freedom from pests. The plants should be strong and vigorous, arising from runners of the same season or, in the case of spring planting, from the season previous to the time of planting. Old plants or weak young plants should not be used. It is desirable to have a plant with good top growth. With most varieties this will mean three or four well developed leaves. It is more important, however, that it possess a good root system. A plant with a large healthy root system and a comparatively small top is much to be preferred to one in which these conditions are reversed. The former will soon develop a large top, while the latter will find much difficulty in putting out new growth. If the roots are dark colored, it is doubtful if it will pay to use the plants.

## Plant Sources

WHEN SMALL AREAS are to be planted, the new plants can be selected from an old plantation provided it is free from pests. If a large number of plants are to be set and home-produced plants used, it is better to have a strawberry nursery. Plants which are taken from a nursery and immediately planted usually do somewhat better than plants which have been dug for some time.

Purchased plants should be promptly and properly cared for on their arrival, as neglect at this time frequently results in failure to get a good stand. Remove the plants from the package as soon as they are received. If they are in good condition and are to be planted within a few hours, all that is necessary is to keep them moist so that the roots will not dry out. If it is necessary to delay planting more than a few hours, the plants should be heeled-in. This process consists in placing the plants in the soil in loosely compact rows. Select a location that is protected from the sun and wind. Spade up the soil, putting it in the same condition as it would be if the plants were to be set permanently. Make a broad, v-shaped trench about eight inches deep. Set the plants along the trench just far enough apart to allow the root system of each to come fully in contact with the soil. Refill the trench, compressing the soil, being careful that the crowns are not covered nor the upper parts of the roots exposed. Place the variety label at the end of the row to avoid any danger of mixing varieties. If the soil is dry, water the plants thoroughly after heeling-in. If it is early in the spring, the plants should be covered to prevent injury from freezing. When so protected, they may be kept for some time without being injured; but, if the temperature is high enough to promote top growth, the cover should be left off or removed. The length of time that the plants are left heeled-in should be as short as possible.

## Spring Planting is Usually Best




EARLY SPRING PLANTING is best in Wisconsin. Sometimes home plantations are set in August or early September so that fruit may be harvested the next season. This procedure is questionable and should not be followed in commercial plantings.

## Planting Distances

THE MATTED ROW SYSTEM is used almost entirely in growing strawberries in Wisconsin. In this sytem the distance between plants in the row depends primarily upon the number of runner plants produced by the variety grown and upon the fertility of the soil. Experimental results indicate that an average distance of at least five or six inches between runner plants is desirable. Plants of varieties which produce numerous runners, as Senator Dunlap, may be set about 30 inches apart and produce a good stand of plants. Shy runner-producers, as Premier, need to be planted 18 to 24 inches apart to give a desirable stand.

The distance between the rows will depend upon the type of tillage and to an extent upon the width of the row of plants, which is usually 15 to 20 inches. Thirty or thirty-six inches is the usual distance for hand tillage, and it is 3-1/2 to 4 feet when horse tillage is used. On very fertile soils, distances should be somewhat greater than on those lacking in plant nutrients.

## Plants Needed

THE NUMBER OF PLANTS necessary to set a given area can be readily determined by using the following table. To determine the number of plants needed, calculate the number of square feet in the tract to be planted and then divide by the factor for the distance of planting used.

| Distance between plants | Distance between rows | Factor |
|---|---|---|
| 12 inches | 2.5 feet | 2.5 |
| 12 inches | 3.0 feet | 3.0 |
| 12 inches | 3.5 feet | 3.5 |
| 12 inches | 4.0 feet | 4.0 |
| 15 inches | 2.5 feet | 3.12 |
| 15 inches | 3.0 feet | 3.75 |
| 15 inches | 3.5 feet | 4.375 |
| 15 inches | 4.0 feet | 5.0 |
| 18 inches | 2.5 feet | 3.75 |
| 18 inches | 3.0 feet | 4.5 |
| 18 inches | 4.0 feet | 6.0 |

When the distance between plants is 24 inches, double the factor for 12 inches and comparable distance between rows; when 30 inches, double the factor for 15 inches.

## Locating the Plants

WHEN PLANTING, it is usually desirable to have the area marked out in at least one direction. Frequently in home plantations, a garden line is used to indicate the location of the row and the distance between the plants either measured or estimated. In small commercial plantings, the same method may be used, or the location of the plants in the row may be determined by marking at right angles to the direction of the rows. When a line is used, care should be exercised not to crowd it out of place or the rows will be crooked. Some growers place the line about 6 inches from the location of the row to avoid the danger of shifting the line when planting.

In large plantations, marking both ways is preferable. There are several ways of doing this, the most common being with a specially constructed sled or pole marker of the corn marker type but with adjustable runners or pins.

## Prune Before Planting

IT IS USUALLY DESIRABLE to prune the plants before setting them. The tops are pruned to reduce moisture losses. The older leaves are removed but two fairly well developed leaves should be left. Some root pruning is also commonly done, however, the roots should be left as long as possible without too seriously interfering with planting. In any event, they should be left at least three to four inches long. Root pruning should not be done until just before planting even when heeling-in is to be practiced.

## Exercise Care in Setting Plants

THREE THINGS are essential in setting strawberries:

(1) The roots must not be allowed to become dry. To allow the roots to dry very much is usually fatal to the plant. Keep them covered with a damp cloth or immerse them in water in a partly filled pail. Another precaution is not to drop the plants much ahead of the planter.

(2) The plants must be set at the proper depth. Plants are properly set when the soil covers the base of the crown but does not cover the crown. Shallower planting exposes the upper portion of the roots to drying out. Too deep planting covers the buds and they may not be able to push out of the soil or will make poor growth. On soils which are likely to wash, particular care should be taken not to set the plant on a sort of little mound or in a depression.

(3) The soil must come in firm contact with the roots. To accomplish this, it should be fine. The roots should be spread out as much as practical and the soil pressed firmly along the entire length of the roots. Planted in this way, all parts of the roots will be in contact with the soil.

## Methods of Setting Plants

THE TROWEL OR DIBBLE and the spade methods are commonly used in the setting of plants. Some growers prefer the spade, while others will use nothing but the dibble, claiming that it is more rapid and insures better work. Either method is satisfactory if care is exercised in doing the work, but neither will give good results if the work is carelessly done. When setting large acreages, some growers use a planting machine such as is used in setting cabbage or tobacco. Great care as regards depth of planting is necessary in machine planting.

In dibble planting, each planter works independently. The dibble is thrust into the soil and by a sideways movement an opening is made for the plant. The roots are thrust into the opening, lowering the plant somewhat below the height it is to stand. It is then raised to its permanent position so that the roots may be well spread out and placed naturally instead of being crowded into a bunch. The dibble is then thrust into the soil a slight distance from the plant and the soil is crowded against the roots. The second opening is filled by knocking loose earth into it. In dibble planting, the men usually work in teams of three. One drops the plants and the other two set them.

When planting by the spade method, two men work together, one to handle the spade and one to prune and place the plants. The spade should have a stiff blade which is smooth and bright as the soil will stick to a rusty one. The spade is thrust into the soil from two-thirds to three-fourths the length of the blade. In this operation, the back of the spade is away from the operator. By a forward and backward movement an opening is made in the soil. The spade is then either wholly or partly removed, depending upon how great a tendency the soil has to fall into the opening. The man who places the plant, working on the opposite side of the row, grasps the plant between his thumb and the palm of his hand, and, using his fingers to spread the roots, inserts them into the opening with a short swinging motion. The spade operator again pushes the spade into the soil about two inches from the first opening, and presses it against the roots. Meanwhile, the man who places the plants presses the soil on the opposite side of the plant with his foot, which insures a good contact between the soil and roots. As with the dibble method, the second hole made in planting is then filled.

## Care Needed After Planting

THREE THINGS will demand attention during the growing season following planting: tillage, blossom removal, and runner distribution and control. Tillage should begin within a few days after the plants are set and continue until the growing season is practically over. The principal object of tillage is to suppress the weeds and, if this is done thoroughly, any other purposes of tillage will ordinarily be adequately met. Hoeing around and between the plants is a necessary part of an efficient tillage program. In addition to controlling weeds, it makes for better rooting of runner plants. Cultivation should be shallow, unless weed control necessitates deep tillage, and it can be as close to the plants as runner development will permit.

Recently there has been considerable interest in the use of materials containing 2,4-D for the control of weeds in strawberry plantings. Beneficial results have been secured in controlling broad-leaved weeds, in some cases serious injury has resulted to the strawberry plants. If it is used care should be taken as regards the strength of material applied and the time it is put on. Present recommendations are to use not more than one pound of actual 2,4-D acid per acre. Common directions are for one pound 2,4-D in 100 gallons of water to one acre. When commercial 2,4-D products are used the amount of a particular brand per 100 gallons can be determined on the basis of the percentage of 2,4-D in that brand. For example, it would be 2-1/2 pounds of a 40 per cent material. This rate of application would be slightly less than one gallon per 100 feet of row. This would require 1/6 ounce of actual 2,4-D acid per 100 feet of row. This material should preferably be used when the strawberry plants are making little growth and should not be applied when they are in blossom or in fruit.

## Grow Plants First Season

THE FRUITING OF PLANTS during the same season as planted or the first season after planting, if set in the fall, is to be discouraged except possibly in home gardens and with everbearing varieties. The plants should exert all their activity the first year in producing good vigorous crowns and strong runner plants. In order to conserve all the strength of the plants for this purpose, the buds or blossoms should be removed as soon as possible after being formed. This is done by pinching off the stems of the flower clusters.

Common practice is to get the runner plants established as soon as possible even though runner plants starting fairly late in the season may under favorable conditions give good results. On the less favorable soil, a side dressing at this time of a readily available nitrogen fertilizer may prove helpful in producing strong plants. Enough to supply 20 to 30 pounds of nitrogen per acre should be used. If a fertilizer carrying 20 per cent nitrogen is used the amount applied would be approximately one to one and a half pounds per 100 feet of row.

## Spacing Plants

AS PREVIOUSLY STATED, experimental results indicated that an average distance of at least 5 or 6 inches between runner plants is desirable for best results. Many growers make very little effort to control the number of runners produced or their location other than cutting off those which project too far into the space between the rows. This method may work fairly well with shy plant makers. However, with varieties which produce a large number of runner plants, unless the number of runner plants which become established in the row is limited somewhat, the row becomes too thick and there is insufficient space for the individual plants to develop properly. These under-developed plants are incapable of producing a heavy crop of large fruits the following season. It is undoubtedly true that the average grower could profitably spend more time in spacing runner plants and thinning out superfluous ones.

## Why Mulch Strawberries

THE PRACTICE commonly called mulching of strawberries is really covering the plants. The immediate reason for covering strawberry plants in Wisconsin is to prevent winter injury, particularly winter root injury which is one of the greatest causes of loss to Wisconsin growers. Injury may occur with the first severe frost and it commonly occurs before the grower is aware that the temperature is low enough to do any damage. As a result, many growers put the cover on too late to give best results. Observations at this Station indicate that in Wisconsin the cover should usually be put on before the soil around the roots freezes one inch deep. The character and the condition of the soil and the amount of foliage on the plants will influence the time and the degree of atmospheric temperature at which this depth of freezing will occur. Usually it will be when the atmospheric temperature is somewhere around 20 degrees F. During the last of October in Southern Wisconsin, the weather conditions usually are such as to warrant putting on the cover. In seasons when warm weather continues until late, covering may be delayed somewhat. This is particularly important if old, fine material is used. Too early covering may cause damage; therefore, one needs to use considerable discretion as to the best time to cover the plants.

## How Much Mulch?

THE MATERIAL used should be sufficient to protect the soil around the roots from severe freezing. There are several factors which influence the amount of material needed to do this. Three of the more important ones are: (1) how well the material used settles - a moderately compact mulch seems to be more effective than a loose one; (2) the severity of the late fall temperature; and (3) the amount of strawberry foliage. As these vary, definite amounts cannot be given. Recommendations differ widely. From two to three inches after settling will probably be sufficient to give satisfactory results if good foliage growth has been secured. This would ordinarily require from 2 to 4 tons of material per acre, depending upon the kind used.

## Character of Mulch

GOOD MULCHING material should be free from weed seed, spread evenly, settle into a reasonably compact layer, and break up readily in the spring. Various materials possess more or less fully these desirable qualities. Wheat, barley, or oat straw, coarse, strawy horse manure, and marsh hay are in most common use, although any one of these may be objectionable if it has too many weed seeds. Marsh hay, if cut at the proper time, is less likely to have weed seeds, but the hay should be cut before the seed ripens enough for germination or it becomes very objectionable. Neither marsh hay nor manure break up in the spring as well as wheat straw; but the manure has the advantage of adding plant food. Oat straw is frequently too foul with weeds to be suitable. Shredded corn stalks, pine needles, so-called burned-out silage, sudan grass hay, and sawdust are sometimes used. Sawdust is not very satisfactory for this purpose.

## Removing the Mulch

USUALLY IT WILL BE necessary to remove some of the mulch from over the rows. Enough should be left on the row, however, so that when the plants grow up through it the fruits will be kept from becoming dirty. The mulch taken off the rows should be placed between the rows to help conserve soil moisture, suppress weeds, and make picking conditions better. If a light mulch was used, all that will be necessary is to loosen it so that the plants can grow through it readily.

The time for removing the mulch depends mostly upon seasonal conditions. The surplus should be taken off the rows when the plants begin growing. This results in a better development of the plants and usually better production than when removal is delayed. Possibly as good an indication as any of the best time is when the young leaves under the mulch first start to turn yellowish.

## Caring for the Crop

HARVESTING seems to be one of the most trying operations of strawberry culture, primarily because of the difficulty of getting reliable pickers. If the strawberry is to reach the market in a salable condition , it must be handled carefully and with the utmost attention to details. It is difficult to get the average picker to realize the importance of these things. When picking strawberries, pinch off the fruit, leaving a small portion of stem on the berry. Pulling the berry from the plant should not be allowed, as many berries will be partly crushed or the stem and calyx will be pulled out, either of which will result in rapid deterioration of the fruit and its failure to stand up well in transit.

It should be the aim to get the berries into the shade as soon after they are picked as practicable. If let to stand in the full sunlight, a box of berries will deteriorate in a very short time to a point where they will be unsatisfactory for commercial use.

Supply the picker with a carrier that holds from four to six boxes. When the picking is good, the larger number is not too many, but when the fruit is ripening slowly and it requires some time to pick a boxful, a smaller number is preferable.

Some growers attempt to have their pickers grade the berries when picking. This is practical only when the pickers are above the average or the fruit is exceptionally uniform. It is not satisfactory if a grower is building up a reputation for superiority. The average boy or girl who picks berries is not qualified to sort or grade the fruit. In most cases, therefore, if the berries are to be graded, it is more satisfactory if the pickers pay no attention to grading. An additional force should be provided to grade and pack the fruit. If this is not done, close supervision of the pickers will be necessary to insure a satisfactory pack.

The question of how ripe the fruit should be when picked is one which bothers many growers. Varying conditions make it impossible to give a definite

rule. Much depends upon the distance that the fruit must be transported. For home use, the berry should be allowed to become fully ripe as then it will have a better flavor. If grown for the local market, the fruit should be entirely colored but showing light at the tip and on the lower side; while, for distant markets, the berries should be red on the exposed sides and pink or slightly white on the under sides or at the tips. In order to secure fruit of the right degree of ripeness, pickings must be frequent. As a rule, there should be not more than one day between pickings, and if the weather is hot and the berries are ripening fast, picking every day gives a better product. However, the fruit should not be picked when it is wet.

## Handling the Bed After Harvest

THE PERMANENCE of the strawberry bed is a question upon which growers do not agree. Some commercial growers harvest but one crop from a field while others take as many as three crops. In beds for home use, this number is exceeded at times. The number of crops which it is profitable to harvest from a plantation depends primarily upon the stand, whether the plants are in good condition, and whether or not it will be cheaper to renovate the old bed than to start a new one. All of these factors depend largely upon the care that has been given the field. If careful attention has been given to proper mulching and to thinning out the plants, keeping pests in check, preventing the weeds from seeding, and adding plant nutrients to the soil, a larger number of crops may be removed than if these matters are given only ordinary attention. Weeds play an important part in the consideration and, as a rule, the difficulty with which they are controlled makes it inadvisable to crop more than two years. Some growers harvest but one crop, claiming that it is cheaper to start a new plantation than to renovate the old one. Some growers who harvest two crops claim larger yields for the second crop than for the first.

## Renovation Practices

RENOVATING THE OLD BED is essential if a satisfactory second crop is to be harvested. This operation varies with different growers and with different systems of planting. It should be done as soon after the harvest as soil conditions permit. Sometimes on heavy soils the dryness and compactness of the soil makes it impractical to begin renovation practices immediately after harvesting is finished. Apparently in such cases the only thing to do is either to irrigate or wait until rain makes tillage possible. However, renovation should not be delayed any longer after harvest than is absolutely necessary. As the matted row is the most common form in Wisconsin, suggestions for renovating will be for plantations of that system.

The principal consideration in renovating is the development of plants strong enough to produce a good crop during the next season. Any renovation operation, therefore, should contribute to plant development.

The first problem is the disposition of the mulch. How this is to be done depends largely on how much there is of it and whether the old leaves are to be burned. If there is not too much, and it is well broken down so it can be easily incorporated into the soil, it is probably advisable to do so unless the leaves are

to be burned. If that is to be done or if it is too much to work into the soil readily, part or all of it should be removed before mowing or burned between the rows with the old foliage.

A second question is what should be done with the old foliage? A good many growers mow and burn or remove the old foliage as a "safety-first" operation. They have decided that on the average the destruction of the old foliage reduces insect and disease pests to an extent which offsets any advantage that the old foliage might have in producing quicker and greater growth of the plants that are to produce the coming crop. If one is certain that it will not make next year's insect or disease problem more difficult, perhaps it will be as well to leave the foliage. When there has been any leaf roller or other serious leaf infestation, it is best to mow off the foliage and burn it between the rows. In using a mowing machine, set the cutter bar so that it will not dig into the plants.

Sometimes the foliage which is mowed off is allowed to dry and is burned on the field. Conditions for this operation must be very favorable if the plants are not to be injured. Ideal conditions for burning are: dry foliage, moist soil, and a strong wind. Because of the difficulty of finding a time when these conditions exist simultaneously, it is usually advisable to rake the material into the space between the rows and burn it there or to remove it from the field.

## Narrowing the Rows

NARROWING THE ROWS is the second operation in renovation. This may be accomplished by any one of several methods. Possibly the most common method is to plow a furrow down either side, throwing them away from the rows, or by running twice between the rows with a two-horse-cultivator. If desired, plowing or cultivating may be done along one side of the row. This method makes sure of getting rid of all the plants originally set, which is desirable. The width of the row left may vary from six to twelve inches, depending upon the stand of plants and the runner-producing ability of the variety. If it has been necessary to delay renovation and growing conditions are unfavorable, the width of the row left may be increased somewhat.

If plowing has been done, till first in the direction of the plowing to fill the furrows, then till across the furrows and the narrowed rows to thin the plants. Cross-harrowing will probably save labor in hand thinning of plants when the rows have been narrowed by using the cultivator. A spike-toothed harrow, adjusted so that the teeth slant backward, is preferable for cross tillage. Some growers use a disc. As cross tillage is commonly practiced, some additional thinning of plants by hand is desirable.

## Fertilization

THERE IS SOME QUESTION as to the value of fertilization as a renovation practice, particularly where a good job of soil preparation was done prior to planting. Practices vary widely. Some growers put well-rotted manure into the furrows and distribute it over the rows, working it into the soil by subsequent tillage. It would seem that a commercial fertilizer would be more bene-

ficial. A moderate application of 6 to 8 pounds per 100 feet of row of a complete fertilizer carrying readily available nitrogen on the lighter soils or one pound of a readily available nitrogen fertilizer on the heavier soils would be good plant food insurance.

After the renovation operations are complete, cultural practices for the remainder of the season are the same as for the first year.

## Strawberry Pests

THERE ARE very few injurious insect pests commonly present in the strawberry plantation. The most serious are the white grub and the leaf roller.

The white grub works in the soil, severing the top from the roots. Avoid planting on newly plowed grass land and do not use grub-infested manure.

The leaf roller larva (commonly called worm) feeds for a short time on the leaflet then draws the edges together and feeds within the fold. The principal control method is the use of a poison applied before the leaflets are folded. Both Rotenone and DDT are quite effective. On fruiting plantings, if the infestation is early, DDT is recommended. After the berries have begun to develop, Rotenone should be used. On new plantings use DDT.

When plantings are carried over, the mowing and burning of leaves immediately after harvest also aids in control. Plantings which are not to be carried over for another crop should be plowed under immediately after harvest. At times leaf rollers may be present on new plantings after the harvesting season. In such cases, the usual control measures should be practiced.

Strawberry leaf-spot is frequently found in plantations. It is identified by the round, reddish-brown or purplish spots. If the less susceptible varieties are planted, control measures are usually not necessary. If the infection is serious, spraying with bordeaux mixture as the new leaves develop will help control the disease.

Wilted strawberry plants. For some years, Wisconsin strawberry growers have had unusual losses due to the plants drying up at about harvest time. There are apparently four principal causes for this condition.

At times inadequate soil moistue is responsible. Occasionally it may be due to white grubs feeding on the roots. This is likely to be the case only when planting has been done on sod land or the plantation has been continued in order to secure more than the recommended two crops.

Another cause could be the red stele disease which is very common in some of our neighboring states. The disease can be quite readily detected in the spring as the central core of the root is red brown when in a normal root it would be white. This disease has not been reported as being present in Wisconsin,

except possibly in a few instances. Special nursery inspection practices are being followed in Wisconsin and other states where the disease is prevalent in an attempt to prevent its spread. While the disease is commonly plant borne, the soil in which plants having the disease are grown becomes infected. The infection apparently remains in the soil for a number of years.

Most of the drying up of strawberry plants in Wisconsin at harvest time is presumably due to winter root injury. Growers are quite likely not to suspect winter root injury as the cause of their trouble. Plants of which the roots have been injured by cold may make reasonably good growth early in the season. As a rule, all the roots are not killed outright. Those that are less severely injured continue to function but less efficiently and they continue to deteriorate. Later in the season there is more foliage to be supplied with water, more water needed because of heavier use due to increased temperature, and often less moisture present in the soil. Under these conditions the impaired root system is no longer able to furnish enough moisture to the plant and it just naturally dries up and turns brown.

Probably a large proportion of root injury occurs in the fall before the mulch has been put on. Under Wisconsin conditions it is not only advisable to mulch strawberries in the fall but the mulching should be done at the time which will reduce as much as possible the liability to root injury. Putting on a sufficient quantity of mulch to give good protection is also necessary to good results. If proper mulching as to time and amount is done, it is quite certain that "strawberry drying" will be materially reduced in most cases.

If this drying up condition occurs in a grower's planting and he is unable to determine the cause of the trouble, he should send entire specimens of affected plants to the Experiment Station so that determination can be made. By so doing, he may not only safeguard his own growing but will also assist in helping to keep a check on the presence of red stele disease in the State.

## Everbearing Strawberries

THE SO-CALLED everbearing strawberry has proved not to be a very satisfactory commercial fruit under Wisconsin conditions. It is grown to a limited extent in home plantations.

The growth and fruting habits which are quite different than those of the June berry, also vary considerably with different varieties. The everbearing varieties do well only when the soil is thoroughly prepared, as directed earlier in this circular. It must be fertile and retentive of moisture if a good crop is to be harvested in the late summer and fall.

Planting may be the same as for June berries, although closer planting is practiced with poor runner-producing kinds, which is true of most of the older varieties. Streamliner and Evermore are fairly good plant makers. Everbearers are more commonly grown in the hill system of planting than the June varieties, especially the very shy runner-producing varieties.

The blossoms should be picked off until about July 15, after which fruit is permitted to develop as long as seasonal conditions permit. Encourage the runners to root as readily as possible. A light mulch under the plants and frequent shallow tillage are conducive to increased production. The maintenance of adequate soil moisture at all times is necessary for the heavy production of good sized fruits.

Give the plants the same winter protection and spring treatment as that given June varieties. The spring crop is not likely to be equal to that produced by June varieties, but it seems desirable in the home plantation to carry the planting over for this crop.

Some growers take a second fall crop, but the production and character of fruit will be below that of the first fall crop. It therefore seems that, where heavy production and large fruit are of major importance, a better practice probably would be to make a new planting each season and harvest from it only a fall crop and a crop the following June.

Many growers consider Gem the most desirable variety, although Mastadon and Wayzata are also frequently planted by Wisconsin growers. Streamliner and Evermore, newer varieties, are attracting considerable attention.

# # #

101

Published and distributed under Act of Congress, May 8, 1914, by the Agricultural Extension Service, College of Agriculture of the University of Wisconsin, W. W. Clark, Associate Director, the United States Department of Agriculture cooperating.